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SOURCE SAMPLING OF THE LANAIR L-110E MULTI-OIL FUELED HEATER. 1982

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ABSTRACT

In October, 1982 the Lanair L-110E Multi-Oil Fueled Heater was tested for source emissions of heavy metals and particulates. While burning waste engine oil with a lead content of between 0.46 and 0.50% (by weight), the average lead concentration in the flue gas was 4672 µg/dscm. The average emission rate of lead was 4.88×10^{-4} kg/h (1.08×10^{-3} lb/h). This represents 34% of the particulate emission rate which averages 1.44×10^{-3} kg/h (3.18×10^{-3} lb/h).

Cadmium, Chromium, barium and manganese were not detected in the flue emissions.

INTRODUCTION

A request was made to the Environmental Management Division by the Manitoba Research Council to conduct a series of source emission tests on the Lanair L-110E Multi-Oil Fueled Heater. Although primarily designed to burn waste crankcase oil, the L-110E will also burn automatic transmission fluid and #1 and #2 fuel oil. Because waste oils from internal combustion engines are contaminated, a concern was expressed on the possible emission of heavy metals (especially lead) and particulates. Testing was conducted at Solv-X Inventions Limited, Winnipeg, Manitoba during October, 1982.

PROCESS DESCRIPTION

The Lanair L-110E heater uses the vaporization technique to burn waste oil. The unit is started by igniting 1½ cups of #1 or #2 fuel oil in the vaporizer pan. When the temperature of the burner pot reaches 120°F a thermal snap disc closes and activates the fuel pump which draws waste oil from the fuel tank. The oil is injected into the vaporizer pan (via a nozzle) where it is immediately vaporized. The vaporized oil is then mixed with air from a combustion blower which is rated at 60 CFM maximum, but factory set at a lower rate to provide the correct amount of air for optimum combustion. Ignition occurs in the lower part of the burner pot around a diffuser ring. The flue gas enters a heat exchanger and is then emitted from the heater by means of a 6" flue pipe. A barometric damper is installed in the flue pipe and adjusted to 0.04 to 0.06 inches of water. Combusted fuel residue must be removed from the vaporizer pan daily. The basic components of the L-110E are illustrated in Figure 1.

A pre-programmed microprocessor monitors safety and combustion parameters. If an unsafe condition arises this control unit shuts down the heater and will not allow a re-start until the unit has cooled down.

Acceptable fuels for this heater include waste engine crankcase oil up to S.A.E. 50 viscosity, automatic transmission fluid and #1 and #2 fuel oil.

Normal consumption is approximately 0.5 imperial gallons per hour.

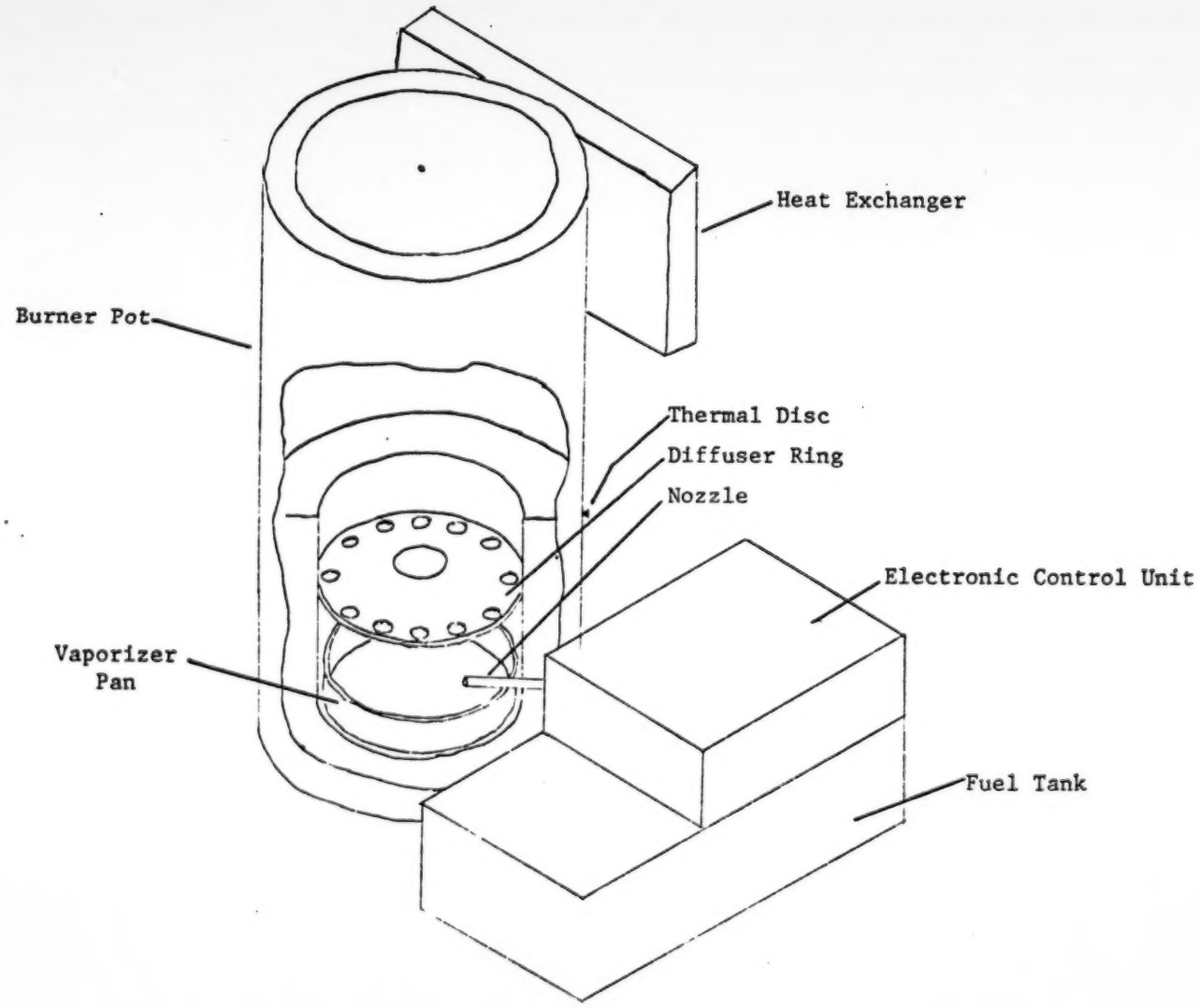

FIGURE 1. BASIC COMPONENTS OF THE LANAIR L-110E

The L-110E model is rated at 100,000 btu/h and is intended to heat work areas from 2,500 to 4,000 sq. ft.

TEST PROCEDURES

Testing was conducted according to EPS 1-AP-78-3. The sample collection system is illustrated in Figure 2. Basically the sampling train consits of a nozzle, glass lined probe, 0.3μ glass fibre filter and five 500 ml Greenburg-Smith impingers. All impingers are of the modified type with the exception of the second which has a standard tip and impaction plate. The first two impingers contain 100 ml of 5% aqua regia solution. The third contains 100 ml of deionized water. The fourth is left empty, while the fifth is loaded with 200 grams of indicating silica gel.

A Bendix Series 4500 Isokinetic Stack Sampler was used to extract the samples from the flue pipe. Flue gas velocity was measured with a S type pitot tube and a Dwyer Model 2000-00 AV Magnehelic Differential Pressure Gauge (range 0-0.25" H_2O, minor division 0.005" H_2O). Dry gas meter and pitot tube calibration sheets are located in Appendix A. A Hays-Republic Model 621A Gas Analyzer was used to determine CO_2, O_2 and CO content of the flue gas.

All sampling was conducted from one sample port located 53 inches (8.8 stack diameters) downstream from a barometric damper. Because of the small diameter of the flue pipe a single sampling point was chosen in the middle of the pipe. The heater was started and then run for one hour before sampling was initiated. Runs 1 and 2 were conducted using the same tank of waste engine oil. For run 3 the tank

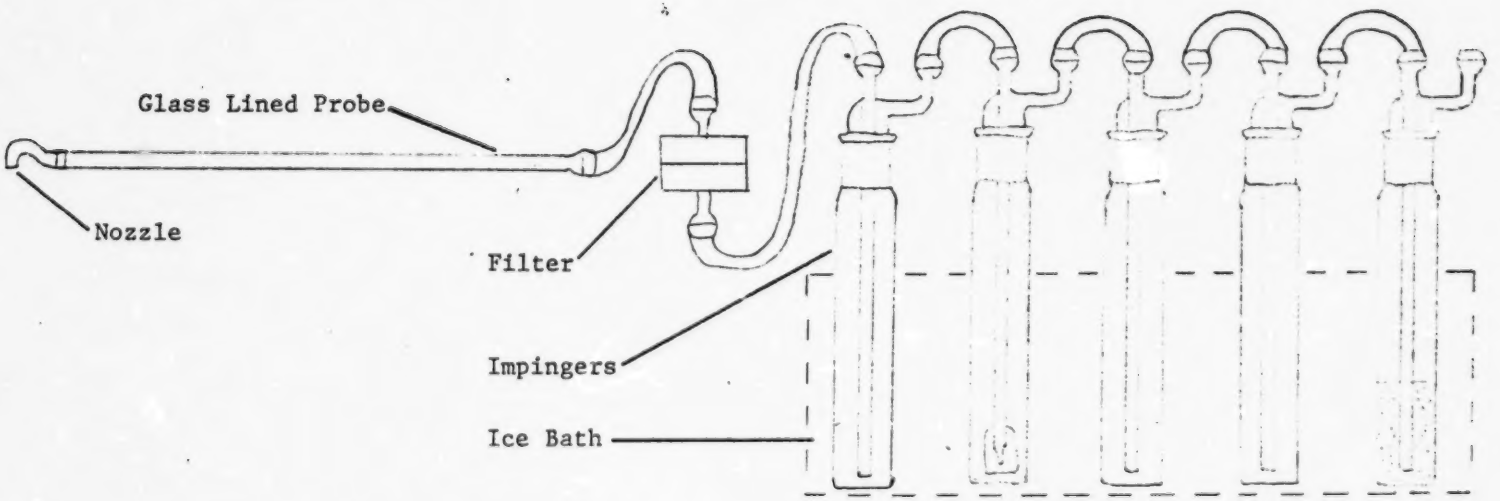

FIGURE 2. SAMPLE COLLECTION SYSTEM

had to be refilled. Waste oil samples were collected during runs 1 and 3.

The waste engine oil burned during testing was obtained from a garage specializing in fast oil changes.

The samples were submitted to the W. M. Ward Technical Services Laboratory for analysis.

The sampling team consisted of Kevin Reeve who operated the control console and Arthur Schultz who operated the sampling module.

RESULTS

The operating characteristics of the L-110E were very uniform in all three tests. Some of the more important sampling variables are summarized in Table 1. Refer to Appendix B for field data.

Each test was of 120 minutes duration to ensure an adequate sample for analysis. Source emission data is summarized in Table 2. The laboratory analysis report is located in Appendix C.

TABLE 1. SUMMARY OF SAMPLING VARIABLES.

TEST NUMBER	1	2	3
SAMPLING DATE	82-10-21	82-10-22	82-10-25
SAMPLING DURATION	120 min.	120 min.	120 min.
SAMPLE VOLUME @ METER CONDITIONS, cu. ft.	54.578	50.143	54.209
SAMPLE VOLUME @ STANDARD CONDITIONS,* dscf	52.306	47.963	51.045
AVERAGE FLUE GAS TEMPERATURE, ^{o}F	263	258	266
AVERAGE FLUE GAS VELOCITY, ft./s	7.7	7.1	7.7
STACK STATIC PRESSURE, in. H_2O	-0.025	-0.025	-0.025
ORIFICE PRESSURE DROP, in. H_2O	0.655	0.575	0.657
AVERAGE GAS METER TEMPERATURE, ^{o}F	93	92	95
ISOKINETIC FACTOR, %	101.4	100.2	100.7

* Standard Conditions are $25^{o}C$ and 760 mm Hg.

TABLE 2. SOURCE EMISSION SUMMARY OF THE LANAIR L-110E.

TEST NUMBER		1	2	3
FLUE GAS COMPOSITION, % BY VOLUME:	CO_2	3.2	3.4	4.0
	O_2	14.6	14.6	14.0
	CO	1.6	1.4	1.1
	H_2O	3.9	4.2	4.5
AVERAGE STACK GAS VOLUMETRIC FLOW RATE, dscm/h, (dscf/h)		108.2 (3821.4)	99.8 (3525.0)	105.6 (3729.0)
CONCENTRATION OF LEAD IN THE FLUE GAS µg/dscm		4389	4786	4841
EMISSION RATE OF LEAD, kg/h, (lb/h)		4.75×10^{-4} (1.05×10^{-3})	4.78×10^{-4} (1.05×10^{-3})	5.11×10^{-4} (1.13×10^{-3})
LEAD CONTENT OF WASTE OIL, % BY WEIGHT		0.46	0.46	0.50
PERCENT LEAD IN SAMPLE		33.2	32.3	36.3
CONCENTRATION OF PARTICULATE IN THE FLUE GAS, g/dscm (gr/dscf)		1.3×10^{-2} (5.8×10^{-3})	1.5×10^{-2} (6.5×10^{-3})	1.3×10^{-2} (5.8×10^{-3})
EMISSION RATE OF PARTICULATE, kg/h, (lb/h)		1.44×10^{-3} (3.17×10^{-3})	1.48×10^{-3} (3.27×10^{-3})	1.40×10^{-3} (3.09×10^{-3})

DISCUSSION

Representative sampling for source emission of particulates is complicated by inertial forces which act on particles. Particulates of varying size and density do not behave identically when the flue gas in which they are travelling becomes disrupted by a sampling train. In order to prevent bias, a method known as isokinetic sampling is employed. In this method the sample enters the sampling train at the same velocity as it was travelling in the stack. Negligible error occurs if sampling is within ±10% of true isokinetic conditions.

If over sampling occurs, inertial properties of larger particles tend to make them separate from the gas stream (in which they were travelling) and pass by the nozzle rather than entering it with the carrier gas stream. If under sampling occurs, too many large particles enter the nozzle per unit of stack gas collected. In both of these cases very small particles follow stack gas streamlines very well and will be collected very close to their true concentration.

In June, 1982, Western Research and Development of Calgary, Alberta conducted a proportional (over sampling) performance evaluation of the Lanair L-110E. In this nonisokinetic test the average lead in the flue gas was calculated to be only 25% of the value found by the Environmental Management Division's isokinetic sampling while the total particulate concentration was found to be 50% greater than the value found by the Environmental Management Division.

A possible explanation for this could be sample bias due to the effect of over sampling. Particulates containing lead may be large enough to be highly affected by their inertial properties and pass by the sample nozzle rather than entering it.

Another reason why the two lead emission concentrations differ by so much may be the oil itself. The waste oil used for the June testing could have had significantly less lead than the waste oil used for the October testing. However, this cannot be evaluated as Western Research and Development did not report any waste oil analysis.

CONCLUSION

Results of the three tests indicate an average lead emmission of 4672 µg/dscm. This corresponds to an average emission rate of 4.88×10^{-4} kg/h (1.08×10^{-3} lb/h) of lead. This represents 32.3 to 36.3% of the total particulate emission.

The average particulate concentration in the flue gas was 1.4×10^{-2} g/dscm (6.0×10^{-3} gr/dscf). This represents an average emission rate of 1.44×10^{-3} kg/h (3.18×10^{-3} lb/h).

Lead content of the waste oil varied from 0.46 to 0.50% (by weight).

Cadmium, chromium, barium and manganese were not deteced in either the waste oil or any of the samples.

BIBLIOGRAPHY

"Lanair Waste Oil Heater, Model L-110 Onwer's and Operator's Manual", Lanair Inc.

"Performance Evaluation" Western Research and Development, File 4502, 1982.

"Standard Reference Methods for Source Testing: Measurement of Emissions of Particulate Matter and Lead from Secondary Lead Smelters", Report EPS 1-AP-78-3, Air Pollution Control Directorate, Environment Canada, June 1979.

APPENDIX A: EQUIPMENT CALIBRATION DATA

DRY GAS METER & ORIFICE METER CALIBRATION DATA

Dry Gas Meter S/N 711030

Average Atmospheric Pressure 738.3 mm Hg or 29.07 in Hg

Calibrated by D.F. & K.R.

Calibrated with large Wet test meter

Ambient/Room Temperature 21.6°C* or 22.2°C

Date 821014

Orifice meter (ΔH)	Wet-test Meter Volume (Vw)	Dry Gas Meter Reading		Dry Gas Meter Volume (Vd)	Wet-test Meter (Tw)		Dry Gas Meter (Ti)	Dry Gas Meter (To)	Time (t)		Wet-test Manometer (Δm)	Wet-test: Dry Gas Meter Ratio (Y)	Flowrate thru' Wet-test Meter @ std. cond. Meter (Qs)	X	Y
		Initial	Final												
in. H_2O	$Ft.^3$	$Ft.^3$	$Ft.^3$	$Ft.^3$	°F.	°C.	°F.	°F.	Min.:Sec.	Minutes	in. H_2O	-	$Ft.^3$/min.	-	
1.05	5.0	846.955	852.018	5.0630	69.0	20.56	100	81	12:19.39	12.3232	0.18	1.00165	0.4074	0.5580	
1.13	5.0	879.067	884.068	5.0130	69.5	20.83	100	83	7:55.60	7.9267	0.36	1.01091	0.6294	0.8527	
1.28	5.0	595.556	890.624	5.0380	69.7	20.94	106	83	6:54.99	6.9165	0.38	1.00971	0.7302	1.0077	
1.05	5.0	892.132	897.196	5.0540	69.8	21.00	111	85	6:05.63	6.0938	0.46	1.01151	0.8194	1.1576	
1.60	8.5	900.725	909.346	8.6210	69.8	21.00	112	86	9:18.92	9.3153	0.48	1.00863	0.9118	1.2945	
2.11	10.5	854.946	865.599	10.6430	69.4	20.78	116	84	9:05.71	9.0951	0.62	1.00567	1.1466	1.6215	
2.16	9.5	927.171	936.865	9.6940	70.0	21.11	115	88	9:34.31	9.5718	0.54	1.00534	0.9937	1.4045	

Linear Regression: Intercept (b) 0.0345

Slope (X) 0.6799

Coefficient of Determination (r^2) 0.9995

Average Y 1.0081 ± 0.0035

ΔH @ 1.9350

Comments:

S-TYPE PITOT TUBE CALIBRATION

PROBE SIZE (ft) 3 — CALIBRATION # 82-40

PROBE LINER Glass — DATE April 19, 1982

PROBE MANUFACTURER R.A.C. — BAROMETRIC PRESSURE (Hg) 29.31

TIP SIZE (inches) 0.492 — AMBIENT TEMP. (°C) 19.7

TIP TYPE Stainless Steel — OPERATOR Kevin Reeve

STACK THERMOCOUPLE ☒ PRESENT

☐ ABSENT

HP 97 INPUT/OUTPUT

Temp	19.7	°C
Bar. Press	29.31	In. Hg
Scale Factor	0.1	
	0.14	Δ p (std)
Tunnel Velocity	7.946	ft/sec
	0.24	Δ p (s-pitot)
Cp, at this	0.761853	velocity
Tunnel Velocity	7.947	(using Cp)

2	0.47	Δ p (std)
	14.558	
	0.81	Δ p (s-pitot)
	0.759835	
	14.561	

3	1.08	Δ p (std)
	22.069	
	1.86	Δ p (s-pitot)
	0.760096	
	22.073	

4	2.00	Δ p (std)		5.90	Δ p (std)
	30.032			51.581	
	3.43	Δ p (s-pitot)		10.22	Δp(s-pitot)
	0.761695			0.757903	
	30.038			51.592	
5	2.90	Δ p (std)		6.79	Δ p (std)
	36.163			55.335	
	4.99	Δ p (s-pitot)		11.78	Δp(s-pitot)
	0.760434			0.757313	
	36.171			55.347	
6	4.26	Δ p (std)			
	43.830				
	7.20	Δ p (s-pitot)		0.760419	Cp (ave)
	0.767276			0.003091	Std. Dev.
	43.839			8	Deg. of Freedom
	5.05	Δ p (std)			
	47.721			2.306	t .05
	8.76	Δ p (s-pitot)		0.758043	Low Cp
	0.757367			0.760419	Mean Cp
	47.731			0.762795	High Cp

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APPENDIX B: FIELD DATA SHEETS

PARTICULATE FIELD DATA SHEET

Unit Lanair L-110E Location Solv-X Inventions Ltd., 1433 Niakwa Rd., Winnipeg

Test number One Date October 21, 1982 Time 11:30 a.m. to 1:30 p.m.

Ambient temperature (°F) 70 Barometric pressure (in. Hg) 29.43 Assumed moisture content 5%

Nozzle diameter 0.494 inches Probe length/type 3 ft./glass Stack static pressure -0.025" H_2O

Probe temperature 330 ± 10°F Filter holder temperature 275±5°F Leak check 0.00 CFM @ 10 " Hg Vacuum

Interval	Clock time (Start)	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
1	0	270	2.175	0.015	0.585	70	70	75	4	105.0
2	5	269	2.091	0.014	0.547	88	70	53	4	104.0
3	10	268	2.236	0.016	0.626	94	71	52	4	103.1
4	15	267	2.180	0.015	0.590	98	72	53	4	102.7
5	20	266	2.185	0.015	0.593	102	73	54	4	102.3
6	25	269	2.196	0.015	0.590	104	74	54	4	102.9
7	30	266	2.194	0.015	0.593	106	75	54	4	102.1
8	35	261	2.216	0.015	0.600	107	76	54	4	103.6
9	40	265	2.267	0.016	0.638	108	78	54	4	102.3
10	45	265	2.340	0.017	0.679	108	78	54	4	102.8
11	50	265	2.403	0.018	0.716	110	79	54	4	101.4
12	55	262	2.401	0.018	0.724	110	80	55	4	102.0
13	60	259	2.322	0.017	0.685	110	81	56	4	100.7

PARTICULATE FIELD DATA SHEET

Unit Lanair L-110E Location _____

Test number One (continued) Date October 21, 1982 Time _____

Ambient temperature (°F) _____ Barometric pressure (in. Hg) _____ Assumed moisture content _____

Nozzle diameter _____ Probe length/type _____ Stack static pressure _____

Probe temperature _____ Filter holder temperature _____ Leak check _____ CFM @ _____" Hg Vacuum

	Clock time	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
14	65	260	2.407	0.018	0.728	111	82	57	4	101.8
15	70	259	2.395	0.018	0.728	112	82	58	4	101.0
16	75	260	2.256	0.016	0.649	112	83	59	4	100.2
17	80	259	2.253	0.016	0.650	112	84	58	4	99.9
18	85	257	2.310	0.017	0.692	112	84	58	4	99.5
19	90	255	2.361	0.018	0.735	113	84	59	4	98.7
20	95	261	2.235	0.016	0.653	113	85	59	4	99.2
21	100	262	2.393	0.018	0.730	114	85	57	4	100.9
22	105	261	2.320	0.017	0.693	114	86	57	4	100.1
23	110	264	2.226	0.016	0.649	113	86	58	4	99.1
24	115	262	2.216	0.016	0.652	114	86	58	4	98.3
Average or total	120	263	54.578	0.016	0.655	-	-	-	4	101.4

PARTICULATE FIELD DATA SHEET

Unit Lanair L-110E Location Solv-X Inventions Ltd., 1433 Niakwa Rd., Winnipeg

Test number Two Date October 22, 1982 Time 11:30 a.m. to 1:30 p.m.

Ambient temperature (°F) 70 Barometric pressure (in. Hg) 29.33 Assumed moisture content 4%

Nozzle diameter 0.494" Probe length/type 3 ft./glass Stack static pressure -0.025" H_2O

Probe temperature 325 ± 5°F Filter holder temperature 275±5°F Leak check 0.00 CFM @ 10 " Hg Vacuum

Interval	Clock time (Start)	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
1	0	254	2.110	0.014	0.568	72	72	66	4	103.6
1	5	253	2.078	0.014	0.573	91	72	62	4	101.1
3	10	255	2.061	0.014	0.570	95	72	63	4	100.1
4	15	256	2.063	0.014	0.570	98	73	62	4	99.9
5	20	256	2.045	0.014	0.570	100	74	61	4	98.8
6	25	256	2.055	0.014	0.572	103	75	60	4	98.9
7	30	256	2.075	0.014	0.573	104	76	59	4	99.6
8	35	257	2.080	0.014	0.575	105	78	58	4	99.9
9	40	258	2.100	0.014	0.575	106	78	58	4	100.8
10	45	258	2.093	0.014	0.574	108	79	58	4	100.2
11	50	258	2.104	0.014	0.574	109	80	59	4	100.5
12	55	258	2.093	0.014	0.576	109	81	59	4	99.9
13	60	259	2.100	0.014	0.577	109	82	59	4	100.4

PARTICULATE FIELD DATA SHEET

Unit Lanair L-110E Location _____

Test number Two (continued) Date October 22, 1982 Time _____

Ambient temperature (°F) _____ Barometric pressure (in. Hg) _____ Assumed moisture content _____

Nozzle diameter _____ Probe length/type _____ Stack static pressure _____

Probe temperature _____ Filter holder temperature _____ Leak check _____ CFM @ _____" Hg Vacuum

Interval	Clock time	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
14	65	259	2.093	0.014	0.577	109	82	59	4	100.0
15	70	260	2.100	0.014	0.578	110	83	60	4	100.4
16	75	259	2.097	0.014	0.577	110	83	60	4	100.0
17	80	260	2.089	0.014	0.578	110	84	60	4	99.7
18	85	259	2.097	0.014	0.579	111	84	60	4	99.8
19	90	260	2.087	0.014	0.579	111	85	61	4	99.5
20	95	261	2.105	0.014	0.579	111	85	62	4	100.5
21	100	262	2.105	0.014	0.577	112	85	62	4	100.4
22	105	261	2.110	0.014	0.578	112	86	62	4	100.5
23	110	261	2.105	0.014	0.580	112	86	63	4	100.3
24	115	260	2.098	0.014	0.579	112	86	63	4	99.8
Average or total	120	258	50.143	0.014	0.575	-	-	-	4	100.2

PARTICULATE FIELD DATA SHEET

Unit Lanair L-110E Location Solv-X Inventions Ltd., 1433 Niakwa Rd., Winnipeg

Test number Three Date October 25, 1982 Time 11:48 a.m. to 1:48 p.m.

Ambient temperature (°F) 70 Barometric pressure (in. Hg) 29.02 Assumed moisture content 4%

Nozzle diameter 0.494" Probe length/type 3 ft./glass Stack static pressure -0.025"H_2O

Probe temperature 330 ± 5°F Filter holder temperature 275±10°F Leak check 0.00 CFM @ 10 " Hg Vacuum

Interval	Clock time (Start)	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
1	0	272	2.046	0.014	0.556	71	72	66	4	102.1
2	5	272	2.060	0.015	0.596	91	72	53	4	99.0
3	10	266	2.125	0.015	0.596	96	72	54	4	100.7
4	15	258	2.229	0.016	0.648	99	73	56	4	101.4
5	20	257	2.228	0.016	0.651	102	74	56	4	100.8
6	25	264	2.214	0.016	0.650	105	75	57	4	100.7
7	30	269	2.214	0.016	0.645	108	77	57	4	99.7
8	35	266	2.215	0.016	0.647	111	78	58	4	99.0
9	40	266	2.332	0.017	0.690	112	79	58	4	101.3
10	45	268	2.345	0.017	0.691	113	81	59	4	102.0
11	50	267	2.236	0.016	0.653	114	82	59	4	99.5
12	55	268	2.252	0.016	0.653	114	83	60	4	100.3
13	60	267	2.258	0.016	0.653	115	83	60	4	100.2

PARTICULATE FIELD DATA SHEET

Unit Lanair L-110E Location _____

Test number Three (continued) Date October 25, 1982 Time _____

Ambient temperature (°F) _____ Barometric pressure (in. Hg) _____ Assumed moisture content _____

Nozzle diameter _____ Probe length/type _____ Stack static pressure _____

Probe temperature _____ Filter holder temperature _____ Leak check _____ CFM @ _____" Hg Vacuum

	Clock time	Stack gas temperature (degrees F)	Gas meter volume cu. ft.	Velocity pressure (in. H_2O)	Orifice pressure drop (in. H_2O)	Gas meter temperature (°F)		Final impinger temperature (degrees F)	Pump vacuum in. Hg	Isokinetic factor, %
						Inlet	Outlet			
14	65	268	2.262	0.016	0.655	115	85	61	4	100.4
15	70	267	2.260	0.016	0.656	116	86	61	4	100.8
16	75	266	2.268	0.016	0.650	116	86	62	4	100.3
17	80	266	2.284	0.016	0.658	116	86	62	4	100.9
18	85	266	2.370	0.017	0.700	117	87	62	4	101.9
19	90	267	2.368	0.017	0.700	117	88	62	4	102.0
20	95	264	2.363	0.017	0.702	118	88	62	4	101.2
21	100	264	2.353	0.017	0.704	118	88	62	4	100.7
22	105	267	2.295	0.016	0.662	118	89	63	4	101.2
23	110	269	2.259	0.016	0.660	118	89	63	4	99.9
24	115	267	2.373	0.017	0.701	119	89	64	4	101.8
Average or total	120	266	54.209	0.016	0.657	-	-		4	100.7

APPENDIX C: ANALYTICAL REPORT

WM. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

SUBMITTER: KEVIN REEVE (IPC)
LOCATION: Lower L-110 Waste Oil Heater
REPORT TO: KEVIN REEVE
STACK EMISSIONS - RUN #1 of 1

L – Less than
G – Greater than

up 3 p 2

SAMPLE - ID from [Y 82] [M 11] [D 21] to [Y] [M] [D]
Date Sampled [Y 82] [M 11] [D 21]
Date Received [Y 82] [M 11] [D 27]

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analyzed
24107	1. Bottle 1.	Pb	L	0.1	mg/l	12/1/82
	Probe Washings	Cd	L	0.02	"	
	Hannover before	Cr	L	.1	"	
	filter	Ba	L	5.	"	
		Mn	L	.05	"	
		Dry Material		.0094	g	
24108	2. Bottle 2.	Pb	L	.1	mg/l	12/1/82
	Impinger 1+2	Cd	L	.02	"	
	contents	Cr	L	.1	"	
		Ba	L	5.	"	
		Mn	L	.05	"	
24109	3. Bottle 3	Pb		46.00	µg/l	12/1/82
	Wash bit	Cd	L	20.	"	
	Sample	Cr	L	100.	"	
	(Final Source)	Ba	L	5000.	"	
		Mn	L	50.	"	
24110	4. Filter	TSP		0.0098	g	12/1/82
	#332	Pb		12.	mg/l	12/1/82
		Cd	L	.02	"	
		Cr	L	.1	"	
		Ba	L	5.	"	
		Mn	L	.05	"	
24111	5. Blank	Pb	L	.1	mg/l	12/1/82
	Bottle #5.	Cd	L	.02	"	
	Aqua Regia 5%	Cr	L	.1	"	
		Ba	L	5.	"	
		Mn	L	.05	"	
24112	6. Filter	TSP		0.0003	g	12/1/82
	#335	Pb	L	.1	mg/l	12/1/82
		Cd	L	.02	"	
		Cr	L	.1	"	
		Ba	L	5.	"	
		Mn	L	5.	"	

Note: above results in mg/l based on ~ 500 ml.

W.M. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM

SUBMITTED: Kevin Kiser (ARC)
LOCATION: Lamar, LHC Waste Oil Heater
REPORT TO: Kevin Kiser
Stack Emissions - Run #2 - 3 of 3 pg 2

L -- Less than
G -- Greater than

From Sequent: Y 82 M 11 D 14
Date Sampled: Y 82 M 11 D 22
SAMPLE ID: NOV 29 1982 Sequent
Date Received: Y 82 M 11 D 23

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analyzed
24113	1. Bottle #1	Pb	L	.1	mg/l	12/1/82
	Probe Washings	Cd	L	.02	"	
	& Nozzle Before	Cr	L	.1	"	
	Filter	Ba	L	5	"	
		Mn	L	.05	"	
		Dry Material		.00715	g	
24114	2. Bottle 2	Pb	L	.1	mg/l	12/1/82
	Impinger #2	Cd	L	.02	"	
	Contents	Cr	L	.1	"	
		Ba	L	5	"	
		Mn	L	.05	"	
24115	4. Filter	TSP		0.0216	g	12/1/82
	#333	Pb		1.3	mg/l	12/1/82
		Cd	L	.02	"	
		Cr	L	.1	"	
		Ba	L	5	"	
		Mn	L	.05	"	

Note: above results in mg/l based on a 500ml. Final volume.

W.M. WARD TECHNICAL SERVICES LABORATORY CHEMICAL ANALYSIS FORM II

SUBMITTED: Kevin Rice (ARL)
LOCATION: Lagoon L-110 Waste Oil Heater
REPORT TO: Kevin Rice
State Emission - Rem" 3 ARL

L – Less than
G – Greater than

Sample Number	Identification or Comments	Parameter	L/G	Value	Units	Date Analyzed
24116	1 Bottle 1	Pb	L	.1	mg/l	8/31/82
	Probe Washings	Cd	L	.02	"	
	& Borosilicate	Cr	L	.1	"	
	Filter	Ba	L	5.	"	
		Mn	L	.05	"	
		Dry Material		.0054	g	
24117	2. Bottle 2.	Pb	L	.1	mg/l	8/31/82
	Impingers 1 & 2	Cd	L	.02	"	
	Contents	Cr	L	.1	"	
		Ba	L	5.	"	
		Mn	L	.05	"	
24118	3. Bottle 3.	Pb		5000.	ug/g	8/31/82
	Waste Oil Sple	Cd	L	20.	"	
	(Fuel Source)	Cr	L	100.	"	
		Ba	L	5000.	"	
		Mn	L	50.	"	
24119	4. Filter	TSP		0.0139	g	8/31/82
	# 334	Pb		1.4	mg/l	8/31/82
		Cd	L	.02	"	
		Cr	L	.1	"	
		Ba	L	5.	"	
		Mn	L	.05	"	

Note: above results in mg/l based on a 500. ml. final volume.